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When teams of employees spin-off partnerships: matching-technology, information structure, and the "pure" incubator effect

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Abstract The successful foundation of entrepreneurial firms comprises a multitude of complementary human tasks. The effect of founders' human capital on firm success hinges on the information structure that prevails when nascent entrepreneurs are matched in partnerships. Empirically, we assume that rational matching occurs in incubated spin-offs and corporate-sponsored ventures. The human capital structure in such firms significantly differs from that of Greenfield projects. Using coarsened exact matching (CEM), we compute weights to level out these differences in human capital endowments. The impact of corporate support in founding the new firm is positive and increases as CEM-weights are applied to more of our human capital variables.

Keywords Founders' human capital · Complementary tasks · Entrepreneurial partnerships · Incubator function · Rational vs. random matching

JEL Classification M13 · L26 · D82

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1 Introduction

Human capital in general, and human capital effects on entrepreneurial team formation in particular, are among the most widely discussed and analyzed issues in entrepreneurial research. Research generally agrees that founders' human capital endowments affect the success of entrepreneurial firms (Rauch et al. 2005; Cassar 2006). Yet, estimates often show only small impacts (Davidsson and Honig 2003; Unger et al. 2011).[1] Lazear (2004, 2005) points out that entrepreneurs must exhibit "jack-off-all-trade" characteristics; their individual entrepreneurial capability is limited by their least-developed skill. To derive this hypothesis in market equilibrium, Lazear assumes that there exist only single entrepreneurs.[2]

However, a significant proportion of entrepreneurial firms are partnerships (Aldrich et al. 2002; Ruef et al. 2003). Early research associates larger teams with the availability of different skills. Schjoed and Kraus (2009) surveys the literature on team composition effects: the processes linking team composition to firm success are complex and empirical findings are inconclusive. In contrast, Colombo and Grilli (2005) confirms the existence of synergies within heterogeneous groups of founders. In partnerships, partners allocate tasks according to comparative advantages. Firms in which the partners' ability profiles provide complementary matches are more successful.

Concerning the mode of entry, Folta et al. (2010) notes that the possibilities of entering into entrepreneurial endeavors are ever increasing and nascent entrepreneurs can chose from a number of options ranging from fully independent new ventures to franchises and corporate spin-offs. Cooper and Bruno (1977) originally coined the term "incubator" to denote spin-off possibilities for high-profile employees of research-intensive industrial corporations. Bhidé (2000, p 54) reports that 71 % of the founders included in the Inc. 500 1989 start-up survey "replicated or modified an idea encountered during their previous employment." Recruiting and matching team members constitutes a key success factor in such new ventures (Bhidé 2000). In part, entrepreneurs can overcome deficiencies in human capital endowments through organizational support.

When relying on an existing organization to sponsor the new venture, some organizational routines are transferred from the sponsoring organization (Cooper and Dunkelberg 1986). Recent contributions emphasize that "external" or "strategic corporate entrepreneurship" serves the parent company's strategic and organizational renewal; it allows learning about new market opportunities and

[1] In part, such estimates hinge on the definition of relevant human capital endowments: specifically, cognitive abilities, typically proxied by the extent of the individual's formal education, are not exclusively decisive for entrepreneurial success. Therefore, studies add measures of business and industry experience (e.g., Colombo and Grilli 2010) and/or experience as an entrepreneur (e.g., Gruber et al. 2008). Following Unger et al. (2011), evidence from a meta-analysis of 70 independent studies reveals that human capital outcome variables, such as acquired skills and available knowledge, exhibit stronger impacts than proxies of human capital endowments.

[2] Current empirical evidence is mixed: Wagner (2006) and Backes-Gellner and Moog (2008) confirm that "jack-of-all-trades"-characteristics increase the probability and willingness to become an entrepreneur. Silva (2007) reports that, upon controlling for socio-economic and demographic characteristics, such individuals are not more successful as entrepreneurs.

business models (Kuratko and Audretsch 2009; Phan et al. 2009). At the same time, the success of such spin-offs depends on the specificity of the technology transfer from the parent company (Clarysse et al. 2011). Information regarding potential partners' task ability profiles allows rational matching and increases the quality of the founding team. Thus, some entrepreneurs benefit from organizational support by parent or sponsoring corporations. However, these benefits do not arise in all new ventures alike which causes self-selection into corporate-sponsored entrepreneurial partnerships (Folta et al. 2010).

Consequently, disentangling choices of entrepreneurs and the corresponding performance implications is difficult due to self-selection and endogenous matching among the involved parties. Then, adding to the problem of adequately measuring founders' human capital endowments, identifying the impacts of such endowments on entrepreneurial success is further aggravated: the quality of matching individuals with complementary human capital profiles matters. Failure to account for the information structure prior to firm foundation risks to mismeasure the relevant, task-related human capital and misinterpret its impact on firm success. Specifically, matching takes place under better information regarding individuals' ability profiles in incubated spin-offs or new ventures sponsored by existing firms. However, parent or sponsoring firms' strategic goals, access to funding, and the type of technology transfer also directly affects the success of the new venture.

We identify a "pure" incubator effect in founding entrepreneurial firms. The "pure" incubator effect reflects improved matching of individuals with different ability profiles into development teams. Theoretically, we compare informed and uninformed individuals' decisions to enter the market for potential entrepreneurs in which they can be matched. We show that both the sets of ability profiles among potential and actual entrepreneurs differ between the two informational scenarios.[3] Therefore, empirical research on the effects of team members human capital endowments on new venture success must account for differences in the information structure which prevails when potential partners meet.

Using data from the second panel study of entrepreneurial dynamics (PSED II) on nascent entrepreneurs, we demonstrate that there exists an incubator effect on firm success which is confined to team foundations and does not apply to single entrepreneurs. Using measures of formal education, industry experience, and experience as an entrepreneur, we distinguish three different human capital endowments. T tests show significant differences in the human capital structure between spin-offs and sponsored firms and Greenfield ventures. Foundations are successful, if they generate positive cash-flows and, according to founders' self-reports, they are operational. Logit-regressions show that spin-offs and sponsored partnerships are more successful, while there is no such effect among single entrepreneurs.

Investigating this effect in more detail, we show that its explanatory power increases as we statistically level out differences in teams' average human capital

[3] In contrast, the effects analyzed by Fabel (2004) are driven by differences in the objective functions between entrepreneurial partnerships and industrial firms. Although the production technology is the same as the one assumed in this paper, there is no effect of the information structure in this study.

endowments. Hence, in entrepreneurial partnerships, venture success is driven by enhanced matching of individual human capital endowment profiles rather than endowment levels. Using coarsened exact matching (CEM), we compute weights to level out the differences in human capital endowments between spin-offs and sponsored partnerships and their Greenfield mirror-images. Upon carrying out this adjustment, the impact of corporate support on venture success further increases. Summarizing, evidence supports that the "pure" incubator function, i.e., the superior matching-technology, affects the success of entrepreneurial partnerships.

The remainder of our paper is organized as follows: in the next section, formal analysis investigates the effect of the information structure on the composition and levels of nascent entrepreneurs' human capital endowments. Section 3 presents empirical evidence regarding the impact of the incubator function on entrepreneurial success. The final section discusses and concludes.

2 A formal model of matching nascent entrepreneurs

2.1 The description of the economy

The development process combines two human tasks, indexed $t = 1, 2$ Each task must be carried out by one individual. Hence, firms consist of development teams, each team comprising two individuals.

The two tasks are complementary. Specifically, production reflects an *O-Ring* technology[4]: imperfect performance of either of the two tasks renders the development process incomplete. An incomplete process generates no revenue. Denote by (a^{1i}, a^{2i}) individual i's ability profile, where $a^{ti} \in [0, 1]$, $t = 1, 2$, is the individual's ability in carrying out task t. We measure task-ability in terms of the probability of successful task-completion. e.g., consider a team where individual i performs task 1 and individual j carries out task 2. This team realizes revenue r with probability $(a^{1i}a^{2j})$. Revenue equals zero with probability $(1 - a^{1i}a^{2j})$. The distribution of ability profiles over the population constitutes public knowledge. However, ability profiles are non-verifiable. Hence, enforceable contracts cannot be conditioned on individual task ability.

Individuals differ regarding the costs of searching for appropriate team members. However, we do not model this search process. Rather, we isolate the effect of the induced information structure on firm foundations; informed (uninformed) individuals have observed all other individuals' ability profiles (no other individual's ability profile) prior to entering the market for potential entrepreneurs. Thus, we distinguish two extreme matching scenarios: with *random matching*, "nature" matches two uninformed individuals in a development team. *Rational matching* implies that informed individuals find team members who provide the best match given their own ability profiles. Said differently, under rational (random) matching, the individuals' ability profiles are *ex-ante* common (private) information.

[4] Kremer (1993).

All individuals can earn the certain wage $\overline{w}$ in industrial employment. Their preferences are characterized by the utility function $U(y)$, where $y > 0$ denotes income. The utility function implies risk-aversion, i.e., $U'(y) > 0$, $U''(y) < 0$, and $\lim_{y \to 0} U'(y) = \infty$. Every individual possesses identical initial wealth $Y > 0$.

Individuals can only commit to enforceable contracts. Hence, the stages of new firm foundation are as follows:

- at date 0, an individual decides to enter the market for potential entrepreneurs if her expected utility as entrepreneur is at least as large as her certain utility in industrial employment. In the rational matching scenario, such potential entrepreneurs observe every other potential entrepreneur's ability profile before making this decision;
- at date 1, potential entrepreneurs are matched into teams of two individuals. In the random matching scenario, team members observe each other's ability profiles. Nash-bargaining determines the governance structure, the capital input, and the task allocation within the potential new firm;
- at date 2, team members either formally contract to found a new firm or not. If one of the two individuals decides against actually founding the firm, both individuals must seek industrial employment. Production begins within the new firms;
- at date 3, "nature" determines project success in the new firms.

To characterize potential and actual entrepreneurs in the two informational scenarios, we apply the following two-step procedure: we begin with date 1 and solve the Nash-bargaining problem of any two individuals that happen to be matched and consider founding an entrepreneurial firm. At date 2, this bargaining has reached a result but the founding contract has not been formally signed yet. Hence, either of the two potential entrepreneurs may still decide to rather seek industrial employment. This assumption serves to define the reservation utilities of the two individuals in their (date 1) bargaining problem.

In a second step, we analyze the individuals' decisions to enter the market as potential entrepreneurs at date 0. Again, the alternative is to immediately seek industrial employment and earn the certain wage $\overline{w}$. In the random matching scenario, matching risk affects the decision to consider becoming an entrepreneur: if, upon reaching a bargaining result at date 2, one of the two potential entrepreneurs decides not to found a new firm, both individuals forgo the alternative wage $\overline{w}$ for one period. With rational matching, there is no such risk.[5] For simplicity, the individuals' discount rate is zero.

2.2 The governance structure of entrepreneurial firms

Suppose two individuals i and j are matched. Let $\overline{a}^{ij} = \{(a^{1i}, a^{2i}), (a^{1j}, a^{2j})\}$ denote the set of their ability profiles. Recall that, at this stage (i.e., at date 1), both

[5] A more realistic model would explicitly consider searching for matching team members rather than only distinguishing two extreme informational scenarios. Then, incubating new firms would imply a reduction of individual search costs. For instance, successful search would last fewer periods over which individuals would have to forgo industrial employment. We are confident that conclusions which are derived from our highly stylized model qualitatively carry over to such more realistic settings.

informed and uninformed individuals have observed each other's task abilities. Generally, if founding a new firm, their expected utilities are given by

$$\begin{aligned} EU^{ij} = {} & T(\overline{a}^{ij})[a^{1i}a^{2j}U(Y-\phi(\overline{a}^{ij})+(1-\beta(\overline{a}^{ij}))[(K(\overline{a}^{ij}))^{\gamma}-\rho K(\overline{a}^{ij})]) \\ & + (1-a^{1i}a^{2j})U(Y-\phi(\overline{a}^{ij})-(1-\beta(\overline{a}^{ij}))\rho K(\widetilde{a}^{i}))] \\ & + (1-T(\overline{a}^{ij}))[a^{1j}a^{2i}U(Y-\phi(\overline{a}^{ij})+(1-\beta(\overline{a}^{ij}))[(K(\overline{a}^{ij}))^{\gamma}-\rho K(\overline{a}^{ij})]) \\ & + (1-a^{1j}a^{2i})U(Y-\phi(\overline{a}^{ij})-(1-\beta(\overline{a}^{ij}))\rho K(\overline{a}^{ij}))], \end{aligned} \tag{1}$$

for individual i, and

$$\begin{aligned} EU^{ji} = {} & T(\overline{a}^{ij})[a^{1i}a^{2j}U(Y+\phi(\overline{a}^{ij})+\beta(\overline{a}^{ij})[(K(\overline{a}^{ij}))^{\gamma}-\rho K(\overline{a}^{ij})]) \\ & + (1-a^{1i}a^{2j})U(Y+\phi(\overline{a}^{ij})-\beta(\overline{a}^{ij})\rho K(\overline{a}^{ij}))] \\ & + (1-T(\overline{a}^{ij}))[a^{1j}a^{2i}U(Y+\phi(\overline{a}^{ij})\ [(K(\overline{a}^{ij}))^{\gamma}-\rho K(\overline{a}^{ij})]) \\ & + (1-a^{1j}a^{2i})U(Y+\phi(\overline{a}^{ij})-\beta(\overline{a}^{ij})\rho K(\overline{a}^{ij}))], \end{aligned} \tag{2}$$

for individual j.

In (1) and (2) $T(\bar{a}^{ij})=1$ if individual i (j) carries out task *1* (*2*) and $T(\bar{a}^{ij})=0$ if individual i (j) carries out task *2* (*1*). $\phi(\bar{a}^{ij})$ denotes a transfer of fixed income between the two team members. Further, member j (i) receives the partnership share $\beta(\bar{a}^{ij})\geq 0$ $(1-\beta(\bar{a}^{ij})\geq 0)$ This share determines the individual's profit claim as well as her liability for losses. E.g., if $\beta(\bar{a}^{ij})=0$ ($\beta(\bar{a}^{ij})=1$), professional i (professional j) becomes a single entrepreneur paying the certain wage $\phi(\bar{a}^{ij})$ to her employee j (employee i). Yet, generally, team members are free to agree on the governance structure, i.e., a distribution of ownership shares and transfers among them.

This structure, investments, and the task allocation are simultaneously determined by (symmetric) Nash-bargaining. Thus, the bargaining outcome solves:

$$\max_{K(\bar{a}^{ij}),T(\bar{a}^{ij}),\phi(\bar{a}^{ij}),\beta(\bar{a}^{ij})} [EU^{ij}-\bar{u}]^{\frac{1}{2}}[EU^{ji}-\bar{u}]^{\frac{1}{2}} \tag{3}$$

subject to

$$T(\bar{a}^{ij})\in\{0,1\}, \tag{4}$$

$$0\leq\beta(\bar{a}^{ij})\leq 1, \tag{5}$$

$$K(\bar{a}^{ij})\geq 0, \tag{6}$$

$$EU^{ij}-\bar{u}\geq 0 \text{ and } EU^{ji}-\bar{u}\geq 0, \tag{7}$$

For parsimony, we assume that individuals do not discount future income. Hence, $\bar{u}=U(Y+\bar{w})$.

Since, at date 2, formal firm foundations are still voluntary, constraints (7) are non-binding in this optimization problem. Let superscript "E" indicate bargain-

ing outcomes: immediately note that, for all $K(\bar{a}^{ij}) > 0$, $\phi(\bar{a}^{ij})$, and $\beta(\bar{a}^{ij})$, maximizing (3) implies $T^E(\bar{a}^{ij}) = 1(0)$ if $a^{1i}a^{2j} \geq (<)\, a^{1j}a^{2i}$. Thus, $q^E(\bar{a}^{ij}) = \max\{a^{1i}a^{2j}, a^{1j}a^{2i}\}$ i.e., the bargained task allocation always reflects comparative advantages in performing the two tasks.

For notational parsimony again, y_s^{ij} and y_{ns}^{ij} (y_s^{ji} and y_{ns}^{ji}) denote the income levels in expression (1) (expression (2)) conditional on project success and failure. The first-order conditions with respect to $\beta(\bar{a}^{ij}), K(\bar{a}^{ij})$, and $\phi(\bar{a}^{ij})$ yield:

$$\begin{aligned}
&\left[q^E(\bar{a}^{ij})U'(y_s^{ij})\left[\left(K(\bar{a}^{ij})\right)^{\gamma} - \rho K(\bar{a}^{ij})\right] - \left(1 - q^E(\bar{a}^{ij})\right)U'(y_{ns}^{ij})\rho K(\bar{a}^{ij})\right]\left[EU^{ij} - \bar{u}\right]^{-\frac{1}{2}} \\
&\quad \left\{\begin{array}{l} \geq \\ = \\ \leq \end{array}\right\} \left[q^E(\bar{a}^{ij})U'(y_s^{ji})\left[\left(K(\bar{a}^{ij})\right)^{\gamma} - \rho K(\bar{a}^{ij})\right] - \left(1 - q^E(\bar{a}^{ij})\right)U'(y_{ns}^{ij})\rho K(\bar{a}^{ij})\right] \\
&\quad \left[EU^{ij} - \bar{u}\right]^{-\frac{1}{2}} \quad if\, \beta(\bar{a}^{ij}) \left\{\begin{array}{l} = 0 \\ \in (0,1), \\ = 1 \end{array}\right. \qquad (8)
\end{aligned}$$

$$\begin{aligned}
&[q^E(\bar{a}^{ij})U'(y_s^{ij})[\gamma(K(\bar{a}^{ij}))^{\gamma-1} - \rho] - (1 - q^E(\bar{a}^{ij}))U'(y_{ns}^{ij})\rho][EU^{ij} - \bar{u}]^{-\frac{1}{2}}(1 - \beta(\bar{a}^{ij})) \\
&\quad = -[q^E(\bar{a}^{ij})U'(y_s^{ji})[\gamma(K(\bar{a}^{ij}))^{\gamma-1} - \rho] - (1 - q^E(\bar{a}^{ij}))U'(y_{ns}^{ij})\rho]E[U^{ji} - \bar{u}]^{-\frac{1}{2}}\beta(\bar{a}^{ij}), \qquad (9)
\end{aligned}$$

and

$$\begin{aligned}
&[q^E(\bar{a}^{ij})U'(y_s^{ij}) + (1 - q^E(\bar{a}^{ij}))U'(y_{ns}^{ij})][EU^{ij} - \bar{u}]^{-\frac{1}{2}} \\
&\quad = [q^E(\bar{a}^{ij})U'(y_s^{ji}) + (1 - q^E(\bar{a}^{ij}))U'(y_{ns}^{ji})][EU^{ji} - \bar{u}]^{-\frac{1}{2}}. \qquad (10)
\end{aligned}$$

We have to distinguish the following cases:

(i) Suppose that $\beta(\bar{a}^{ij}) = 0$. In this case, (10) implies

$$\begin{aligned}
&q^E(\bar{a}^{ij}) + (1 - q^E(\bar{a}^{ij}))\frac{U'(Y + \phi)(\bar{a}^{ij}))}{U'(Y - \phi(\bar{a}^{ij}) - \rho K(\bar{a}^{ij}))} \\
&\quad = \frac{[EU^{ji} - \bar{u}]^{-\frac{1}{2}}}{[EU^{ij} - \bar{u}]^{-\frac{1}{2}}}\frac{U'(Y + \phi(\bar{a}^{ij}))}{U'(Y - \phi(\bar{a}^{ij}) + (K(\bar{a}^{ij}))^{\gamma} - \rho K(\bar{a}^{ij}))}. \qquad (11)
\end{aligned}$$

The expected surplus $q^E(\bar{a}^{ij})(K(\bar{a}^{ij}))^{\gamma} - \rho K(\bar{a}^{ij})$ is positive if $K(\bar{a}^{ij}) > 0$ (i.e., if production takes place). Then, (11) contradicts that the LHS of (8) can be greater or equal than the RHS.

(ii) Similar arguments as in (i) above serve to exclude the case $\beta(\bar{a}^{ij}) = 1$.

(iii) Consequently, $0 < \beta^E(\bar{a}^{ij}) < 1$. Hence, conditions (10) and (8) imply

$$\begin{aligned}
&\left[q^E(\bar{a}^{ij})(K(\bar{a}^{ij}))^{\gamma} - \rho K(\bar{a}^{ij})\frac{(1-q^E(\bar{a}^{ij}))U'\left(y_{ns}^{ij}\right)}{U'\left(y_{s}^{ij}\right)}\right] \\
&\quad\times\left[q^E(\bar{a}^{ij}) + \frac{(1-q^E(\bar{a}^{ij}))U'\left(y_{ns}^{ij}\right)}{U'\left(y_{s}^{ij}\right)}\right] \\
&= \left[q^E(\bar{a}^{ij})(K(\bar{a}^{ij}))^{\gamma} - \rho K(\bar{a}^{ij})\frac{(1-q^E(\bar{a}^{ij}))U'\left(y_{ns}^{ij}\right)}{U'\left(y_{s}^{ij}\right)}\right] \\
&\quad\times\left[q^E(\bar{a}^{ij}) + \frac{(1-q^E(\bar{a}^{ij}))U'\left(y_{ns}^{ij}\right)}{U'\left(y_{s}^{ij}\right)}\right].
\end{aligned} \tag{12}$$

The second terms on each side of (12) are positive. Thus, suppose the first terms on both sides of the equation are also positive. In this case, (12) implies

$$\frac{U'(y_s^{ij})}{U'(y_{ns}^{ij})} = \frac{U'(y_s^{ji})}{U'(y_{ns}^{ji})}. \tag{13}$$

This implication may be violated if, and only if, both first terms on each side of (12) are negative. Yet, in that case, (12) and (9) would contradict. Hence, (13) must be satisfied in the optimum.

Jointly (10) and (8) yield

$$\frac{[EU^{ji} - \bar{u}]^{-\frac{1}{2}}}{[EU^{ij} - \bar{u}]^{-\frac{1}{2}}}\frac{U'(y_s^{ij})}{U'(y_s^{ji})} = 1. \tag{14}$$

Then, (14) and (13) imply $\phi^E(\bar{a}^{ij}) = 0$ and $\beta^E(\bar{a}^{ij}) = \frac{1}{2}$. The capital input rule follows from insertion into (9): $K^E = K^E(q^E(\bar{a}^{ij});\ \rho)$ is implicitly determined by

$$\begin{aligned}
&q^E(\bar{a}^{ij})U'\left(Y + \frac{1}{2}\left[(K^E)^{\gamma} - \rho K^E\right]\right)\left[\gamma(K^E)^{\gamma-1} - \rho\right] \\
&\quad = \left(1 - q^E(\bar{a}^{ij})\right)U'\left(Y - \frac{1}{2}\rho K^E\right)\rho.
\end{aligned} \tag{15}$$

Hence,

$$\frac{\partial K^E}{\partial q^E} = \frac{U'\left(Y + \frac{1}{2}\left[(K^E)^{\gamma} - \rho K^E\right]\right) - U'\left(Y - \frac{1}{2}\rho K^E\right)}{\Delta} > 0, \tag{16}$$

since $\Delta = \frac{\partial^2 EU^E}{(\partial K^E)^2} < 0$. Also,

$$\frac{\partial EU^E}{\partial q^E} = U\left(Y + \frac{1}{2}\left[(K^E)^{\gamma} - \rho K^E\right]\right) - U\left(Y - \frac{1}{2}\rho K^E\right) > 0 \tag{17}$$

Summarizing, with risk-averse individuals and financial investments at risk, the bargained governance structure always constitutes a partnership of

equals.[6] Consequently, the two partners' investments and expected utilities are identical. Both are monotonically increasing with team quality $q^E(\bar{a}^{ij})$ which is determined by allocating tasks according to comparative—rather than absolute—advantages.

2.3 The market for potential entrepreneurs

2.3.1 Market entry under rational matching

Consider four individuals, denoted k, l, m, and n. All four are of the informed type. Let k and l form one partnership, leaving m and n to found a second firm. Without loss of generality, assume that $q^E(\bar{a}^{kl}) \leq q^E(\bar{a}^{mn})$. If, at the same time, $a^{ti} > a^{tj}$ for one $t = 1, 2$, with $i = k, l$ and $j = m, n$, either k or l could team up with m or n to found a partnership which yields higher expected utility for both individuals. However, this outcome would contradict that such informed individuals maximize their individual utility. Hence, optimal task allocations within each partnership and $q^E(\bar{a}^{kl}) \leq q^E(\bar{a}^{mn})$ jointly imply

$$\begin{aligned}
&\text{(a) } q^E(\bar{a}^{kl}) = a^{1k}a^{2l} \text{ and } q^E(\bar{a}^{mn}) = a^{1m}a^{2n} \Rightarrow a^{1k} \leq a^{1m} \wedge a^{2l} \leq a^{2n},\\
&\text{(b) } q^E(\bar{a}^{kl}) = a^{1l}a^{2k} \text{ and } q^E(\bar{a}^{mn}) = a^{1m}a^{2n} \Rightarrow a^{1l} \leq a^{1m} \wedge a^{2k} \leq a^{2n},\\
&\text{(c) } q^E(\bar{a}^{kl}) = a^{1l}a^{2k} \text{ and } q^E(\bar{a}^{mn}) = a^{1n}a^{2m} \Rightarrow a^{1l} \leq a^{1n} \wedge a^{2k} \leq a^{2m},\\
&\text{(d) } q^E(\bar{a}^{kl}) = a^{1k}a^{2l} \text{ and } q^E(\bar{a}^{mn}) = a^{1n}a^{2m} \Rightarrow a^{1k} \leq a^{1n} \wedge a^{2l} \leq a^{2m}.
\end{aligned} \tag{18}$$

where at least one inequality must be strict in cases (19) (a, b, c, d).

Hence, rational matching results in a sorting of individuals into partnerships: an individual with highest ability in task t teams up with an individual who is characterized by the highest ability in the other task τ, where $t, \tau = 1, 2$ and $t \neq \tau$. Then, individuals with next to top ability in task τ founds an entrepreneurial firm with a partner whose ability in task τ is second-ranked as well. Finally, an individual with the lowest ability in task t teams up with a partner of lowest ability in task τ.

Let $\bar{q}$ denote the minimum team success probability such that two matched individuals decide to found an entrepreneurial partnership. Thus, with zero discount rate,

$$\bar{q}U\left(Y + \frac{1}{2}\left((K^E(\bar{q}))^{\gamma} - \rho K^E(\bar{q})\right)\right) + (1-\bar{q})U\left(Y - \frac{\rho}{2}K^E(\bar{q})\right) = U(Y + \bar{w}) \tag{19}$$

There exists no matching risk in the market for informed entrepreneurs: given the sorting mechanism and (17) above, individual i can be sure to become an entrepreneur if, and only if, $\max\{a^{i1}, a^{i2}\} \geq \sqrt{\bar{q}}$; individuals whose ability profiles do not satisfy this condition can be sure never to find a partner such that founding a

[6] If individuals were risk-neutral, a continuum of governance structures $\{\phi(\bar{a}^{ij}), \beta(\bar{a}^{ij})\}$ could solve the bargaining problem. Thus, from the introduction, recall that Lazear (2004, 2005) *assumes* that there exist only single entrepreneurs who hire an employee to become a team member. Then, this employee receives a certain wage.

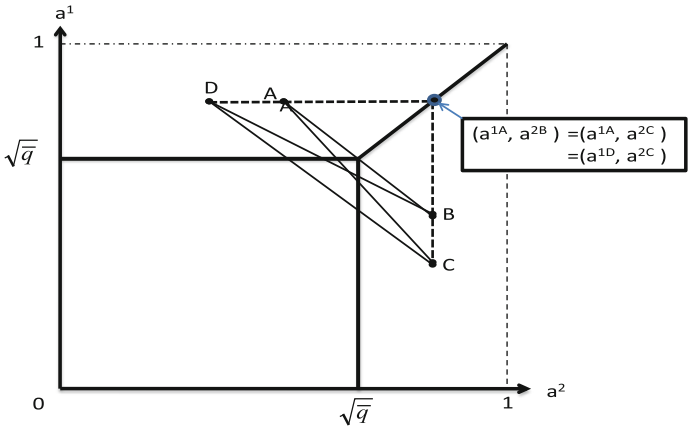

Fig. 1 Average individual and team-abilities under rational matching

new firm dominates industrial employment. Consequently, everyone who enters the market for entrepreneurs actually teams up with a partner to found a new firm.

Figure 1 illustrates market entry decisions and their consequences for team quality under rational matching: in (a^1, a^2)-plane, small dots represent individual ability profiles and large dots indicate the task-related ability combinations realized in entrepreneurial partnerships. All individuals with ability levels greater or equal than $\sqrt{\bar{q}}$ in at least one of the two tasks enter the market and, eventually, become entrepreneurs. Due to rational matching, all task-related team ability combinations are located on the diagonal line connecting $(\sqrt{\bar{q}}, \sqrt{\bar{q}})$ and (1,1). Thus, individuals D and A could both match up with either individual B or C to realize the same team quality. At the same time, both D and A would not be able to find a partner with higher a^2-level than B and C, and they would not agree to found a partnership with individuals who exhibit lower ability in task 2.

Average ability within the team, where this average is taken over the two partners' abilities in the two different tasks, must be located on one of the lines (D,C), (A,C), (D,B), or (A,B). Assuming that ability levels correspond to measurable human capital endowments, empirical studies typically use such unweighted averages when investigating human capital effects on firm success. However, (16) and (17) imply that the partnership's capital investments and project success are increasing only in the maximum of the two individual task ability levels. Thus, when informed partners match rationally, partnerships with different (unweighted) average human capital acquire the same amount of financial capital and realize the same success probability.

2.3.2 Market entry under random matching

Next, consider the case where "nature" randomly matches uninformed individuals in the market for entrepreneurs. For every individual i with ability profile (a^{i1}, a^{i2}), the quality of the match constitutes a random variable $\tilde{q}^E(i) = \max\{a^{i1}a^2, a^{i2}a^1\}$

with $(a^1, a^2) \in S$, where S is the set of ability profiles of potential entrepreneurs. As usual, we assume that individuals share identical expectations regarding the distribution of these ability profiles. Further, these expectations are supported by the actual market entry decisions.

Given these assumptions and (19) above, individual i enters the market for potential entrepreneurs, if

$$\begin{aligned} & E_{\tilde{q}^E(i)}\left\{ q^E(i)U\left(Y+\frac{1}{2}\left(\left(K^E\left(q^E(i)\right)\right)^{\gamma}-\rho K^E\left(q^E(i)\right)\right)\right)\right. \\ & +\left(1-q^E(i)\right)U\left(Y-\frac{\rho}{2}K^E\left(q^E(i)\right)\right)\Big| \left. q^E(i)\geq \bar{q}\right\} \\ & +\ E_{\tilde{q}^E(i)}\left\{prob\left(q^E(i)<\bar{q}\right)\right\}U(Y)\geq U(Y+\bar{w}), \end{aligned} \tag{20}$$

where $q^E(i)$ denotes a realization of $\tilde{q}^E(i)$ Without knowledge of the (equilibrium) joint distribution of (a^1, a^2), it is impossible to assess the realized average ability levels across individuals and the expected maximum task abilities in partnerships that are actually founded.

In Fig. 2, small dots again represent individual ability profiles and large dots indicate the task-related ability combinations realized in entrepreneurial partnerships. The figure depicts the two boundary cases that can occur conditional on the alternative wage $\bar{w}$. If $\overline{\mathrm{w}} = 0$, every individual who can expect to found a partnership with positive probability—i.e., $prob(q^E(i) > q > 0$, for at least one $(a1, a2) \in S$—will enter the market for entrepreneurs. Given that, at date 0, every possible ability profile has positive density, market entrants i are characterized by $\max\{a^{i1}, a^{i2}\} \geq \bar{q}$. In this case, "nature" could match up individuals X and Z to found a partnership. Also, individuals D and C and individuals E and F found partnerships if they happen to be matched. In contrast, if X is matched with Y, both potential entrepreneurs agree to rather seek industrial employment.

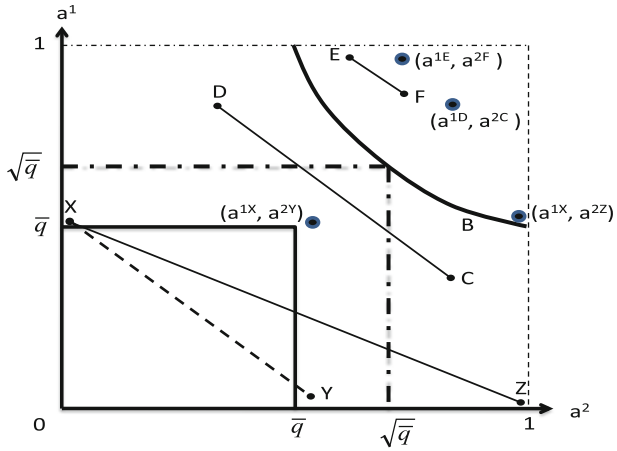

Fig. 2 Average individual and team-abilities under random matching

Now, let the alternative wage $\bar{w}$. increase. To enter the market for entrepreneurs, individuals require a higher probability to find a partner such that founding a new firm is the dominant choice. In the limit, individuals only enter the market, if they can be sure to be matched up with a partner such that $prob(q^E(i) > \bar{q}) = 1$, for all $(a^1, a^2) \in S$. Graphically, in equilibrium, all potential and actual entrepreneurs' ability profiles must be located on or above the curve that is implicitly defined by $a^1 a^2 = \bar{q}$, connecting points $(1,\ \bar{q})$ and $(\bar{q}, 1)$ in Fig. 2. E and F would still become entrepreneurs, while individuals B, D, X, Y, and Z would not even enter the market for potential entrepreneurs. Note that we investigate a model of entrepreneurial partnerships rather than single entrepreneurship. Yet, only in this second limiting case of random matching, Lazear's (2004, 2005) "jack-of-all-trades"-hypothesis actually applies to partnerships as well: jointly, more balanced ability profiles and higher average ability increase the probability to find a matching partner and to found a new firm. Then, further note that the results of single entrepreneur analysis generally do not carry over to investigating the performance effects of human capital structures in partnerships: with rational matching, the "jack-of –all trades," successful single entrepreneur is replaced by a team of partners balancing the skills of task specialists. And, this conclusion results from assuming a production technology with complementary tasks—hence, using the same assumption which enters Lazear (2004, 2005), only adding the possibility of risk-sharing within partnerships.[7]

2.4 Empirical implications

The model shows that, with complementary tasks, the impact of the information structure on the quality of matching nascent entrepreneurs obfuscates the possibility to empirically test human capital effects: rational matching implies that the sum of task-specific human capital endowments over all members of a partnership should be higher compared to randomly matched teams. However, due to the selection into the pool of potential entrepreneurs, comparisons of non-task-specific aggregates of entrepreneurial partnerships' human capital endowments are generally ambiguous. Therefore, regression analysis using stocks of team members' joint endowments as explanatory variables does not allow inferring the impacts of these different types of human capital on firm success. Specifically, given that partnership incentives induce task allocation according to comparative advantages, it is impossible to predict the impact of average or total team human assets on venture performance without identifying the information structure at the time of firm foundation.

Direct empirical tests would therefore require identification of the individual partners' task-assignments and the task-specific optimal human capital mix. To our knowledge, such data on entrepreneurial partnerships does not exist. Thus, we proceed by analyzing a data set which has been widely explored by other researchers before. Its characteristic features are well-documented in the existing literature. We distinguish incubated spin-offs and start-ups that are sponsored by existing firms from Greenfield projects. To organize the partnership, the former can

[7] To our knowledge, we are first to show that, albeit only in this boundary case, "jack-of-all-trade" properties characterize entrepreneurial partners as well.

draw on the relevant pool of current colleagues. Using existing business contacts, potential partners may also be found in the supporting firms' suppliers, customers, or competitors. Thus, this variable marks differences in the information structure regarding potential partners' ability profiles prior to entering the pool of nascent entrepreneurs. We concentrate on only two hypotheses:

1. there exists a "pure" incubator effect which only applies to entrepreneurial partnerships;
2. success of entrepreneurial partnerships is enhanced by incubating to match partners.

To test hypothesis (1), we compare single entrepreneurs with partnerships while controlling for a large set of individual, project-specific, and environment-specific variables. Focusing on hypothesis (2), we need to show that this "pure" incubator effect applies to matching individuals with different human capital endowments. Thus, we (statistically) level out differences in the teams' average human capital endowments. To support our second hypothesis, the absorbent power of the incubator-variable indicating differences in the information structure must increase.

3 Empirical analysis

3.1 The data

We draw on the second panel study of entrepreneurial dynamics (PSED II). PSED II is a representative survey of entrepreneurial activities in the United States that portrays individuals during their business creation process. The dataset describes the characteristics of nascent entrepreneurs, documents the sequences of the organizing activities, summarizes the types and quantities of resources committed, and characterizes the new ventures.[8] The term nascent entrepreneur refers to individuals who intend to start a new firm, have already carried out some activity to help start the business, expect to own part of the firm, and do not yet own an operational business. Nascent entrepreneurs are involved in an ongoing but not yet operational start-up. However, such individuals may possess entrepreneurial experience from the foundation of previous ventures. Hence, the term "nascent" exclusively reflects the current and ongoing effort to create a new firm. In the empirical part, we distinguish between different variants of pre-start-up experience in the empirical part in which we provide respective definitions.

PSED II identifies individuals in late 2005 and early 2006, with four recurrent follow-up interviews in 12 months intervals. The last wave E collects data in January 2010. The survey initially addressed 31,845 individuals. Out of this probability sample, 1,214 active nascent entrepreneurs are identified on grounds of screening questions. These questions establish whether they intend to start-up a new firm, carried out at least one start-up activity in past years, expect to own part of the

[8] Detailed descriptions of the sampling method used to generate PSED II and an overview on the data structure can be found in Reynolds and Curtin (2009).

firm, and do not already own an operational business. Hence, the sample's entrepreneurs are involved in an ongoing but not yet operational start-up. This early stage screening ensures that the data is representative, and, more importantly, reduces distortions due to survivorship biases. Throughout the data collection process, respondents provide affirmative answers concerning a package of start-up activities. The longitudinal structure derived from re-interviewing over the course of 5 years, with monthly indications of activities which are started and finished, allows for inferences regarding the process of organizing activities and, generally, facilitates causal inferences among dependent and independent variables.

Due to non-response and venture disbandment, only 972 of the 1,214 nascent entrepreneurs of Wave A are still included in Wave B. This number decreases to 746, 526, and 435 in Waves C to E. 460 of the original start-ups disbanded their venture, while 228 perceived their venture as operational; 247 reported still ongoing organizing activities in Wave E, but did not perceive their venture as operational. Lastly, 279 start-ups out of the initial sample do not report in at least one wave. We omit these observations.[9] For comparison purposes, there are 381 single entrepreneurs among those 688 who either disband or report to be operating. However, our analysis concentrates on the remaining 307 firms which are organized as partnerships.

3.2 Definitions of variables

3.2.1 Dependent variable: completion of entrepreneurial organizing activities

Our success measure avoids problems associated with the use of researcher-defined or self-reported outcome measures. We define foundations as successful if they generate positive cash-flow and, according to founders' self-reports, they are operational. Specifically, our measure combines questions A35 and A41 of PSED II—i.e., whether monthly revenues ever exceeded monthly expenses for a period of 6 month (including salaries for the managers), and whether, based on this achievement, the respondents would characterize their venture as being operational. Only if both conditions are satisfied, the dependent variable attains the value of one. We label this outcome "perceived venture emergence."

We compare these firms with those which indicate to have abandoned their venture. Davidsson and Gordon (2011) report the existence of "dilettante dreamers" or hobbyists in nascent entrepreneurial sample. To rule out such cases and to make the nascent phase comparable across start-ups, the study suggests comparing start-ups excluding this "still trying" category (see also Parker and Belghitar 2006). Accordingly, we prune all observations that document a "still-trying" status in Wave E. Following Delmar and Shane (2003), we check whether all members of

[9] We tested for sample selection and attrition biases using our explanatory variables and whether or not respondents omit filing responses. Among the variables, only age and education influence the subsequent filing of responses positively (at the 1 and 5 % level, respectively). Hence, the sample resembles a slightly more educated and older population of nascent entrepreneurs than the initial sample of entrepreneurs. However, none of the other main explanatory variables is related to the subsequent filing of responses across the waves.

partnership report disengagement. If some members remain active, we do not treat the venture as disbanded. Rather, due to its "still trying" nature, we omit the observation as well.

3.2.2 Explanatory variables

The following are variables of key interest:

Formal education: Respondents were asked to indicate the highest level of education for each members of the entrepreneurial team. We recode this variable, ranging from elementary school to PhD, into number of years of education (see e.g., Davidsson and Honig 2003; Iacus et al. 2011). Thus, a high school degree implies 12 years of education, a college degree is taken to require 16 years of education, and a PhD yields 20 years of education.

Industry experience PSED II provides information regarding years of work experience in the new venture's industry, years of full-time paid work experience, and years of managerial, supervisory, or administrative responsibilities of the nascent entrepreneurs. Combining the factors, the value of Cronbach's alpha is 0.72.

Entrepreneurial experience: entrepreneurial experience includes all ventures which an individual has founded or helped to found. Generally, such experience is valuable regardless of the ventures' success (Kaiser and Malchow-Moeller 2011). We use information on the number of other businesses which our subjects previously helped to start as an owner and the number of other businesses which they have owned. The correlation among these two variables is 0.6; the value of Cronbach's alpha is 0.65 when combining these factors.

All of these human capital endowment variables are calculated as averages across all team members. Then, our key informational variable is defined as:

Incubated: responses to question AA10 in the PSED 2 data set allow identifying entrepreneurs who either pursue a spin-off and purchase their firm, or are sponsored by an existing organization. The variable takes on the value one in case of such corporate affiliations and equals to zero otherwise.

3.2.3 Control variables

Social contexts in which entrepreneurs organize their in which new ventures and their individual characteristics may differ widely. Such features may influence the number of activities which a nascent entrepreneur is able to pursue as well as whether the partnership could benefit from incubating. Thus, we include a number of control variables:

Age: we control for the average age of team members as reported in Wave A.

Team size: this variable adds up all members of the partnership as of Wave A.

Motivation: we follow Dimov (2010) and include questions from PSED II on entrepreneurial motivation into our empirical analysis. The reflective measure of start-up motivation comprises the answer to the question of whether the respondent agrees with the statements: "There is no limit as to how long I would give maximum effort to establish my business" and "My personal philosophy is to do whatever it takes to establish my own business." We include the average of these

two scores into the empirical analysis. The Cronbach's alpha is 0.71, comparable to Dimov (2010).[10]

Self-efficacy: We measure self-efficacy using the five questions identified in Dimov (2010). The questions employ a five-point Likert-type scale. The Cronbach's alpha is 0.68 (corresponding to questions AY4 to AY8 from PSED 2). The original PSED 2 scale is inverted so that higher values indicate higher levels of self-efficacy.[11]

A growing body of research in entrepreneurship suggests that the nature of the opportunity which is pursued influences organizational actions (Shane 2003; Dencker et al. 2009). And, more importantly, entrepreneurs are aware of such differences when selecting which opportunity to pursue. We attempt to control for such effects by including the following variables:

Industry: we include dummy variables that identify the following industries: retail, consumer services, health, consulting, manufacturing and construction, real estate and finance, and other industries. Identifying the reference group, we omit this last dummy in each regression to avoid perfect collinearity.

Market newness: respondents were asked to assign the number "3" if "all customers will be unfamiliar with this new product or service", "2" if "some customers will be unfamiliar with this new product or service", and "1" if "none of the customers will be unfamiliar with this new product or service". Dahlqvist and Wiklund (2011) include this variable when constructing an index to represent the newness of a product or service to customers.[12]

Competition: we measure the entrepreneur's perception of competition using a three-point scale: "3" is associated with the response "there are many other businesses offering the same product or service," "2" captures the perception that "there are few other businesses offering the same product or service," and the response "there are no other businesses offering the same product or service" yields value "1."

3.3 Incubator effect on partnership success

Table 1 summarizes the details for the underlying sample of this study including 435 nascent ventures that are founded by teams of entrepreneurs. 35 % of these ventures report their status as "operational/emerged." In some 65 % of cases the ventures have been disbanded by all founders. Approximately 25 % of the entrepreneurial teams report a "still-trying" status as per wave E. These

[10] We acknowledge that the reliability of this measure is somewhat weak. Yet, one question from Dimov's (2010) measure was not included in the resampling of PSED 2. We also estimate the model without this measure; the results do not change noticeably. Moreover, responses are only available for the respondent and not for all team members.

[11] Townsend et al. (2010) includes only a subset of three questions AY6 to AY8 in their analysis. However, to make our results comparable to previously published studies, we e follow Dimov (2010). We also estimate a variant using only the questions identified in Townsend et al. (2010); again, the results do not change noticeably.

[12] We regress this measure on the probability of engaging in the development of a proprietary technology or process, or whether entrepreneurs apply for a patent or get a patent granted. All coefficients are positive and highly significant at 0.1 % level. Hence, we are confident that this measures proxies of market newness of the firms' products.

Table 1 Summary statistics and correlation matrix

Variable	Mean	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Perception of emergence	0.35																	
Disbandment	0.65	−0.90																
Incubated	0.13	0.21	−0.20															
Formal education	14.5	0.08	−0.05	0.06														
Entrepreneurial experience	0.64	0.04	−0.05	0.13	0.17													
Industry experience	12.8	0.13	−0.14	0.10	0.19	0.39												
Self-efficacy	4.28	0.04	−0.02	−0.02	−0.10	0.03	−0.02											
Motivation	4.04	0.07	−0.02	−0.01	−0.19	0.01	−0.06	0.49										
Market newness	1.62	−0.09	0.05	−0.10	0.05	0.05	−0.09	0.03	−0.06									
Competition	1.29	−0.01	0.02	0.10	−0.02	−0.11	−0.06	−0.02	−0.01	−0.30								
Team size	2.38	−0.04	0.02	0.00	0.18	0.07	0.05	0.17	0.07	0.10	−0.09							
Age	42.7	0.02	−0.02	0.10	0.19	0.32	0.82	−0.07	−0.05	−0.05	−0.10	0.08						
Retail	0.12	−0.07	0.08	−0.05	−0.06	0.09	0.01	0.05	0.04	0.02	−0.10	−0.05	0.02					
Consumer services	0.36	−0.03	−0.02	−0.02	0.02	−0.04	−0.12	−0.10	−0.11	0.06	0.09	−0.08	−0.09	−0.28				
Health	0.07	0.02	−0.05	−0.02	0.17	−0.04	0.01	0.06	0.01	0.01	−0.10	0.10	0.07	−0.10	−0.20			
Consulting	0.06	0.06	−0.08	−0.05	0.10	0.14	0.11	−0.01	−0.12	0.03	−0.06	0.07	0.09	−0.09	−0.18	−0.07		
Real estate/finance	0.07	0.02	0.04	−0.06	0.13	−0.07	−0.10	−0.05	−0.03	−0.08	0.11	0.01	−0.12	−0.10	−0.20	−0.07	−0.07	
Manufacturing/ construction	0.11	0.01	0.07	0.08	−0.07	0.00	0.13	0.05	0.07	−0.02	−0.03	0.06	0.04	−0.14	−0.27	−0.10	−0.09	−0.10

Summary statistics are based on 307 observations (teams only) and correlation matrix is based on 298 observations. All correlations above 0.1 are significant at least at the 5 % level

observations are omitted from our data set and not tabulated. Performances within PSED II are similar to those reported by other studies analyzing new firm creation in the US (Spletzer et al. 2004; Reynolds 2009). Table 1 presents the summary statistics and correlation matrix. On average, nascent entrepreneurs in the sample have an education level equivalent to some 15 years of formal education (with a standard deviation of around 2 years), 13 years of industry experience, and almost half of the entrepreneurs have been involved (either assisting or owning) in a previous start-up. Incubated entrepreneurial teams represent roughly 15 % of the sample.

The dichotomous nature of the dependent variable implies using logit regressions on "perceived venture emergence" vs. the reference category "venture disbandment." All regression results are collected in Table 2.

Regressions (1) and (3) in Table 2 provide the baseline models for single entrepreneurs and partnerships. Among the human capital variables, only Industry Experience shows a significant positive impact on venture success in both groups of firms. Most notably, incubating exhibits a positive and significant impact only for partnerships. There is no such effect in the group of single entrepreneurs. This difference indicates that, within our sample, the parent company's strategic interests and/or the specificity of the technology transfer does not affect venture success; otherwise, the effect should arise for both single entrepreneurs and team foundations. PSED II is known to contain relatively few high-tech ventures. Hence, this finding does not necessarily conflict with previous studies which report such effects. However, for exactly this reason, the data set is particularly well-suited to serve our analytic goals: incubating the venture appears to be exclusively related to the induced quality of a partnership. Also, note that self-efficacy shows a positive significant effect only for single entrepreneurs. It is tempting to interpret this difference to imply that the single entrepreneur's self-perceived organizational effectiveness substitutes for the possibility of task-division in partnerships. As should be expected, Age reduces the success probability for both groups of ventures.

Table 3 reports simple t tests to show that, except for formal education, the entrepreneurs' human capital endowments are higher in incubated partnerships. Also, there is a significantly higher share of incubated ventures which perceive their venture as successfully emerged over the observation period. Hence, we cannot be certain that the effect of incubating in regression (3) is actually due to different human capital structures within such partnerships compared to Greenfield ventures. At this stage, we would still need to concede that the performance differences could reflect differences in aggregate endowment levels.

Simply regressing a dummy variable capturing the incubation decision on the outcome of the process is only valid if the incubating firms make mistakes (i.e. strategies are random), or if all factors driving the outcome are observable (Shaver 1998). Both conditions are unlikely to be satisfied for our non-experimental data. Hence, inferring the counterfactual from the control groups that are contained in the data could lead to erroneous results due to selection effects. Accordingly, we control for the imbalance across the incubation and non-incubation group to infer whether selection and additional value-added effects are associated with the incubating organization. To ensure that we can infer the counterfactual from the control group,

Table 2 Logit regression perception of emergence against disbandment

Model type/Unit of analysis	(1) Logit Solo	(2) CEM-Logit Solo	(3) Logit Team	(4) CEM-Logit Team	(5) CEM-Logit Team	(6) CEM-Logit Team	(7) CEM-Logit Team	(8) CEM-Logit Team
Incubated	0.132	0.114	0.324***	0.297***	0.341***	0.317***	0.359***	0.446**
	(0.170)	(0.238)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Formal education	0.011	0.007	0.021	0.030^{+}	0.022	0.027	0.013	−0.074
	(0.362)	(0.591)	(0.236)	(0.090)	(0.202)	(0.145)	(0.524)	(0.123)
Industry experience	0.017***	0.018***	0.027***	0.027**	0.023**	0.032***	0.022*	0.019
	(0.000)	(0.000)	(0.001)	(0.001)	(0.003)	(0.000)	(0.033)	(0.419)
Entrepreneurial experience	0.022	0.027	−0.026	−0.003	−0.067^{+}	−0.035	−0.073	−0.027
	(0.419)	(0.346)	(0.512)	(0.945)	(0.083)	(0.416)	(0.231)	(0.871)
Self-efficacy	0.158**	0.157*	0.007	0.010	−0.006	0.035	−0.001	−0.067
	(0.008)	(0.011)	(0.917)	(0.884)	(0.927)	(0.610)	(0.986)	(0.680)
Motivation	−0.018	−0.014	0.061	0.036	0.049	0.041	0.090^{+}	0.176*
	(0.568)	(0.669)	(0.150)	(0.415)	(0.249)	(0.336)	(0.068)	(0.046)
Market newness	0.013	0.028	−0.047	−0.057	−0.048	−0.050	−0.074	−0.157
	(0.710)	(0.457)	(0.287)	(0.220)	(0.263)	(0.270)	(0.159)	(0.113)
Competition	0.012	0.023	−0.050	−0.050	−0.056	−0.037	−0.014	−0.036
	(0.729)	(0.513)	(0.226)	(0.235)	(0.177)	(0.390)	(0.763)	(0.685)
Team size			−0.041	−0.002	0.006	−0.055	−0.030	−0.032
			(0.341)	(0.967)	(0.871)	(0.211)	(0.520)	(0.783)
Age	−0.008*	−0.008*	−0.014**	−0.015**	−0.012*	−0.016**	−0.013*	−0.029*
	(0.021)	(0.023)	(0.005)	(0.005)	(0.015)	(0.002)	(0.027)	(0.030)
Retail	0.013	0.026	−0.088	−0.017	−0.091	−0.099	−0.083	0.414*
	(0.899)	(0.807)	(0.365)	(0.877)	(0.320)	(0.314)	(0.443)	(0.018)

Table 2 continued

Model type/Unit of analysis	(1) Logit Solo	(2) CEM-Logit Solo	(3) Logit Team	(4) CEM-Logit Team	(5) CEM-Logit Team	(6) CEM-Logit Team	(7) CEM-Logit Team	(8) CEM-Logit Team
Consumer services	0.069	0.040	0.001	0.017	−0.064	0.001	0.054	0.183
	(0.408)	(0.641)	(0.995)	(0.847)	(0.419)	(0.994)	(0.571)	(0.290)
Health	0.025	−0.002	0.058	0.083	−0.012	0.134	0.080	
	(0.829)	(0.989)	(0.668)	(0.545)	(0.921)	(0.334)	(0.624)	
Consulting	0.069	0.088	0.150	0.130	0.161	0.084	0.336*	0.462
	(0.561)	(0.485)	(0.321)	(0.368)	(0.252)	(0.579)	(0.041)	(0.126)
Real estate/finance	0.145	0.097	0.054	0.043	−0.001	0.043	0.174	−0.000
	(0.225)	(0.428)	(0.692)	(0.764)	(0.996)	(0.764)	(0.277)	(1.000)
Manufacturing/construction	−0.046	−0.078	−0.059	−0.022	−0.060	−0.084	−0.017	0.052
	(0.634)	(0.428)	(0.550)	(0.833)	(0.537)	(0.412)	(0.897)	(0.837)
Chi-square	37.97	36.72	34.22	30.86	34.97	39.11	36.50	40.91
P > chi-square	0.001	0.001	0.005	0.014	0.004	0.001	0.002	0.000
Observations	376	360	298	284	297	298	255	96

Marginal effects

Coefficients correspond to the marginal effects for the independent variables calculated at the mean levels of the remaining variables. Regression 2 and 5, 6, 7, 8, 9 uses CEM-weights to rebalance the treatment and control group

$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3 T tests for differences in mean values of non-incubated vs. incubated ventures

Variable/type of sample	Non-incubated vs. incubated entrepreneurs
Formal education	−0.377 (−1.20)
Industry experience	−2.150^{+} (−1.82)
Entrepreneurial experience	−0.316* (−2.34)
Perception of emergence	−0.253** (−3.16)

Values indicate differences in mean values for the corresponding variables and are calculated as the difference between non-incubated and incubated entrepreneurial teams. T-statistics for a two-tailed test for differences in mean values are shown in parentheses

$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

we employ CEM (Iacus et al. 2011; Singh and Agrawal 2011). In contrast to other matching methods, CEM reduces the covariate imbalance between the treatment group, the incubated foundations, and the control group of Greenfield projects without the need to re-examine the balance and, likely, to re-estimate the model (Iacus et al. 2011; Ho et al. 2007): based on Scott (1992) data is temporarily coarsened into groups and matched exactly in the coarsened data bins. Subsequently, the actual ("uncoarsened") data on the matched observations is used in the empirical analysis of causal effects. The ex-ante specification ensures common support; all matched observations within bins are, by definition, in the area of common support. Thus, there is no need to test this feature ex-post. Moreover, since the balance is not achieved using an empirical model, e.g. by linear regression or maximum likelihood estimator, CEM reduces model dependence (Imbens 2004).

Matching helps controlling for some (or all) confounding pre-treatment covariates. It makes the empirical estimation less model-dependent, prunes observations that have no close match within both the control and the treatment group, and removes heterogeneity with respect to human capital endowments. Hence, it ensures a better balance between the treatment and control group. As a consequence, the covariates in both groups are more similar. Thus, inferences are possible despite the potential pre-treatment endogeneity caused by matching through the incubating organization. By comparing the effects across the different sets of models, we can also infer performance variations caused by selection through rational matching.

Regression models (4) to (6) in Table 3 apply CEM-weighting to reduce the imbalance only for one the human capital endowment variables, namely formal education (in model (4)), industry experience (in model (5)), and entrepreneurial experience (in model (6)). Recalling Table 3, industry and entrepreneurial experience showed significant differences between incubated and Greenfield partnerships. Hence, model (7) applies CEM-weighting to both of these variables. Then, regression (8) is carried out with CEM-weighting for all three human capital endowment variables. For completeness and comparison, we also report a CEM-weighted regression for the group of single entrepreneurs as model (2). Results confirm that there is no particular benefit of incubating such ventures.

In strong contrast to this result for ventures led by single entrepreneurs, incubating ventures retains its highly significant positive effect on venture success.

Table 4 T-tests sample means between single entrepreneurs and team ventures

Variable/type of sample	Model 4: solo vs. team Matched sample	Model 5: solo vs. team Matched sample	Model 6: solo vs. team Matched sample	Model 7: solo vs. team Matched sample	Model 8: solo vs. team Matched sample
Formal education	−0.0147	−0.0445	−0.0457	−0.172	−0.129
	(−0.11)	(−0.32)	(−0.33)	(−1.12)	(−0.83)
Industry experience	0.873	1.033*	0.836	0.905^{+}	−0.224
	−1.64	−1.97	−1.61	−1.83	(−0.31)
Entrepreneurial experience	−0.00865	−0.0854^{+}	−0.021	−0.105*	−0.106*
	(−0.12)	(−1.67)	(−0.30)	(−2.50)	(−2.19)
Perception of emergence	−0.0369	−0.0434	−0.0445	−0.0567	−0.0762
	(−0.99)	(−1.20)	(−1.23)	(−1.45)	(−1.32)

Values indicate differences in mean values for solo vs. team venture *after* CEM matching. T-statistics for a two-tailed test for differences in mean values are shown in parentheses

$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

To rule out that these effects constitute artifacts associated with the particular matching method, Table 4 reports differences in mean values of the core variables used in models 5–9 of Table 2: there are no significant differences in formal education, industry experience, and entrepreneurial experience between single entrepreneurs and team entrepreneurs upon matching contingent on these core variables. Hence, the effect derived for the incubation variable is robustly related to the probability to perceive the venture as emerged. Matching on more variables implies that more observations are pruned since incubated partnerships do not find a matching Greenfield project. Thus, the number of observations decreases. This effect is most notable when comparing model (8) which only uses 96 observations with models (4) (5) (6) which are based on more than 280 observations each and model (7) which still rests on 255 observations.[13] This feature warrants some caution when comparing coefficients. Yet, we are confident that our results uncover an increasingly strong effect of incubating partnerships as CEM-weighting levels out more inequalities in the teams' human capital endowments; the absorbent power of the variable identifying incubated partnerships increases. Since this effect is net of the selection into either of the two groups of partnerships, it lends support for the existence of additional value-added effects which are "purely" associated with incubating.

At the same time, team size remains insignificant throughout the different models. Hence, total human assets of the partnerships appear irrelevant. Lastly, in all but model (8) which applies CEM-weighting to all three human capital variables,

[13] With respect to comparing statistically significant and non-significant coefficients, we follow the extant literature on comparing coefficients within logit and probit models. Hoetker (2007) p 338, for example, notes that "If the model is estimated separately for each group, the researcher can—at a minimum—compare the statistical significance of the coefficients across groups. This is possible because the coefficients and standard errors are consistent within each group. One could report, for example, that x has a significant and positive impact for Group 1, but is not significant for Group 2."

Industry Experience retains a distinctly separate positive effect on partnership performance. As noted above, model (8) can only rely on 96 observations. Thus, we cannot rule out that this effect may exist robustly. Recall that Industry Experience actually comprises years of work experience in the industry and in managerial positions which reflect opportunities for on-the-job learning or training. Possibly, then, learning on-the-job can actually substitute rather than complement lacks of formal education and entrepreneurial experience.

4 Discussion and conclusions

Our formal model assumes that entrepreneurial partnerships combine complementary human tasks. Since partners will allocate tasks according to comparative advantages, the effect of founders' human capital on firm success hinges on the information structure that prevails when nascent entrepreneurs are matched in partnerships. Empirically, we assume that rational matching occurs in incubated spin-offs and corporate-sponsored ventures. Comparisons with single entrepreneurs show that the incubator effect is confined to partnerships. Then, among partnerships, the human capital structure significantly differs between incubated ventures and Greenfield projects. Using CEM, we compute weights to level out these differences in human capital endowments. The impact of corporate support in founding the new firm is positive and increases as CEM-weights are applied to more of our human capital variables.

Data limitations preclude direct tests of our model of task complementarities. Although PSED II contains a variety of human capital measures on individual level and information regarding tasks which need to be completed for venture emergence, it does not allow identifying the allocation of these tasks among partners. Thus, our empirical analysis cannot uncover optimal task-specific human capital mixes. However, our results should raise interest in pursuing this issue further: we are confident to have identified a "pure" incubator effect. This effect is neither due to selecting individuals with higher levels of human capital into spin-off partnerships, nor—as demonstrated by comparisons with single entrepreneurs—reflects technology transfers or strategic interests of parent companies. The available theory alternative suggests that incubating improves the information structure when matching individuals with complementary task-abilities.

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